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ALNUS

(alders)

The alders (*Alnus*) total about 30 species of shrubs and trees in the north temperate zone. Shrubs continue north into the arctic regions. In the United States 8 species attain tree size and 1 is shrubby. Only 1 is important as a forest tree. A few more tree species occur in Mexico and Guatemala, and 1 southward in mountains to northern Argentina. The others are in Eurasia south to northern Africa, Iran, Himalayas, and Taiwan.

Alders have smooth to scaly, usually gray bark. The winter buds are usually stalked and formed by 2 or 3 scales meeting by edges. The deciduous alternate leaves are short-petioled, ovate, and usually doubly saw-toothed, often also wavy.

The minute male and female flowers are borne mostly in early spring (rarely in autumn) on different catkins of the same tree (monoecious). A few long, drooping male catkins are clustered near end of twig, while the few short female catkins are erect and lateral. The fruits are small hard blackish cones, clustered and persistent, which in summer mature and release many minute, usually wingless nutlets.

F–490661

RED ALDER (*Alnus rubra* Bong.)

Other common names: Oregon alder, western alder, and Pacific coast alder.

Red alder, the largest species of the genus, is the most important hardwood of the Pacific Northwest and coastal Alaska. Its range is confined to the Pacific coast region from southeastern Alaska to western British Columbia, and south through Washington, northern Idaho, and western Oregon to Santa Barbara in southern California, extending from latitude 60° southward to latitude 34°. Although it grows along streams in northern Idaho, red alder ordinarily occurs no farther inland than 100 miles and at elevations no higher than 2,500 feet.

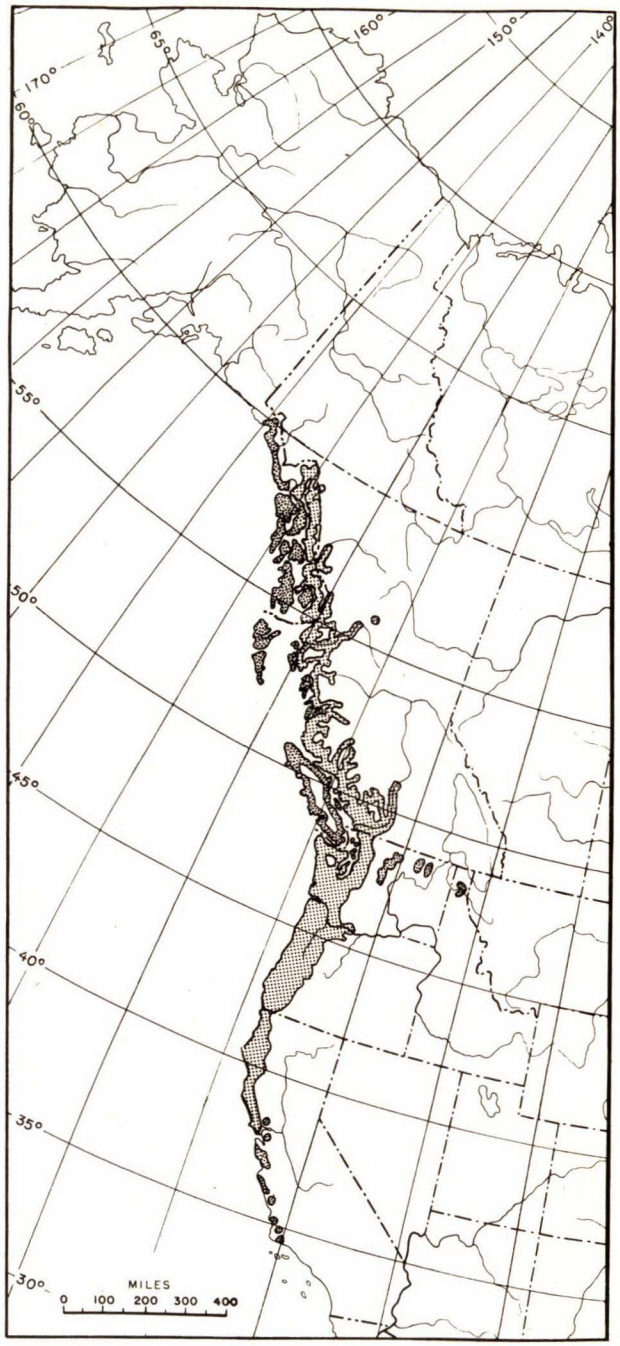
HABITAT CONDITIONS

Climate

Red alder grows in a humid or superhumid climate. For good development the tree needs an annual rainfall in excess of 25 inches, unless the deficit can be compensated for by nearness to the ocean or high humidity. Over most of the tree's range, annual precipitation varies from 25 to 120 inches. During the summer dry period (June–September), however, rainfall may be as low as 5 inches or less. Minimum temperatures much below 0° F., or extended periods of near zero temperature, definitely limit its range. Annual temperature extremes vary from zero, or slightly below, to 105°, or slightly higher at the southern extremity of its range (table 1).

Soils and Topography

Red alder grows on soils varying from gravel or sand to clay. Although it tends to be more prevalent on soils of restricted internal drainage, it is not found in bottomlands subject to consistent overflow (*12*).[1] Some of the more common soil series on which alder grows are the Alderwood, Astoria, Bow, Everett, Indianola, Kapowsin, Kitsap, Melbourne, Olympic, and Squalicum. These soils are normally derived from sandstone, shale, basalt, or granite parent material. Best red alder stands are on deep, well-drained loams or loamy sands of alluvial origin. Throughout the Puget Sound Lower Columbia River drainages of Washington and the Coast Range of Oregon, the species is prevalent on most alluvial soils and extends up the lower slopes until accelerated drainage limits tree development. In Alaska and northern British Columbia, stands are found on narrow bands of soil outwashed from higher elevations, and frequently as a pioneer species on fresh avalanches. California stands are usually confined to stream



F–506571

The range of red alder.

[1] Italic numbers in parentheses refer to Literature Cited, p. 87.

TABLE 1.—*Climatological data for locations within the range of red alder (Alnus rubra)*

Location	Elevation	Average annual precipitation	Average annual snowfall	Temperatures				Frost-free days
				Average July	Average January	Lowest	Highest	
Alaska:	*Feet.*	*Inches*	*Inches*	° *F.*	° *F.*	° *F.*	° *F.*	*Number*
Sitka	67	87	(1)	54. 9	32. 4	−5	87	159
Canada:								
Vancouver, B.C	22	57	29	63. 7	36. 2	2	92	219
Washington:								
Everett, Snohomish County	120	32	10	61. 6	38. 3	3	98	213
Olympia, Thurston County	190	46	15	62. 8	37. 0	−2	104	191
Aberdeen, Grays Harbor County	12	83	12	59. 7	39. 4	6	105	191
Oregon:								
Astoria, Clatsop County	220	78	5	60. 9	40. 3	10	97	273
Tillamook, Tillamook County	26	89	5	68. 0	33. 7	1	101	182
Newport, Lincoln County	155	66	1	56. 8	43. 7	1	100	248
California:								
Crescent City, Del Norte County	45	75	1	59. 3	46. 0	19	102	234
Santa Barbara, Santa Barbara County	120	18	(2)	66. 1	53. 0	20	115	329

[1] Not available.
[2] Trace.

courses. Soils are not a serious limitation except as they affect availability of soil moisture.

Alder contributes both to physical and chemical improvement of soil. Its litter decomposes rapidly, forming a mull humus layer, with subsequent improvement in soil structure. Also it contributes to improved soil fertility through symbiotic fixation of nitrogen by organisms contained in the root nodules (*10*). The role of such organisms has been conclusively demonstrated with European alder (*4*).

Alder foliage contains much greater amounts of nitrogen than leaves of other indigenous tree species (*16*), and soil nitrogen, nitrogen content of fir foliage, and growth rate of fir all increased significantly in mixed plantings of alder and Douglas-fir (*15*). The mean annual accumulation rate for nitrogen in these plantings was about 35 pounds per acre. Studies of a recently deglaciated area in Alaska show the mean annual accumulation rate for nitrogen to have been 55 pounds per acre during the period of plant succession in which Sitka alder was becoming established (*5*).

At the northern extremity of its range (latitude 60° N. in Alaska), red alder grows close to sea level. At latitude 56° N. in British Columbia, however, it has been found 200 miles inland east of the Coast Range, and at an elevation of approximately 2,300 feet (*7*). Throughout western Washington and western Oregon, it grows from sea level to 2,500 feet elevation. It seldom occurs east of the Cascade or Sierra Nevada Ranges. In California, the tree occurs mainly on the seaward side of coast ranges within the fog belt.

The best stands of alder occur under 1,500 feet elevation in Washington and northern Oregon, from Bellingham, Wash., to Florence, Oreg. (latitude 49° N. to 44° N.). At lower elevations it occurs on all slopes, except that in areas of lower precipitation and higher temperatures north- and east-facing slopes are favored. Red alder seldom occurs on steep south or southwest slopes because of moisture deficiency.

Associated Trees and Shrubs

Red alder occurs in five cover types of western North America. It is the major component in the Red Alder Type (Type 221), and a minor one in the Sitka Spruce (Type 223) and Sitka Spruce—Western Hemlock (Type 225) Types. It occurs occasionally in Alaska in the White Spruce—Birch Type (Type 202) and is a minor component of the Black Cottonwood—Willow Type (Type 222). Red alder is found patchwise and as single trees in the Pacific Douglas-Fir, Douglas-Fir—Western Hemlock, and Western Redcedar Types as well. Pure stands are confined chiefly to lower elevations in stream bottoms, moist flats, or lower slopes.

Western redcedar, western hemlock, grand fir, Sitka spruce, Douglas-fir, vine maple (*Acer circinatum*), bigleaf maple, and black cottonwood are characteristic associates of red alder.

Minor tree associates are western birch in its northern range; cascara buckthorn (*Rhamnus purshiana*) and Oregon ash (*Fraxinus latifolia*) in the central range; and redwood, Port-Orford-cedar, and Oregon ash in the southern range.

Common shrubs associated with red alder are

F–475462

A stand of red alder in a bottom.

Pacific red elder (*Sambucus callicarpa*), blueberry elder (*S. cerulea*), salmonberry (*Rubus spectabilis*), western thimbleberry (*R. parviflorus*), American devilsclub (*Oplopanax horridus*), and osoberry (Indian plum) (*Osmaronia cerasiformis*).

LIFE HISTORY

Reproduction and Early Growth

Flowering and fruiting.—Flowers in red alder are borne in the spring, and expand before or with the leaves. Conelets, ½- to 1-inch long and ⅓- to ½-inch thick at maturity, contain 50 to 100 small, flattened nutlike seeds.

The following dates show the range of principal growth events for 17 Oregon and Washington stations, at elevations ranging from 200 to 1,500 feet, and for a typical station, Fortson in Snohomish County, Wash., latitude 48° N., elevation 500 feet:

Event	*17 Stations (range)*	*Fortson (average)*
Leaf buds burst	Mar. 21–Apr. 23	Apr. 3
Completely leaved out	Apr. 9–May 16	May 2
Flowering begins	Feb. 19–May 4	Mar. 29
Flowers all fallen	Mar. 18–June 5	Apr. 12
Fruit ripe	Aug. 5–Oct. 29	Aug. 27
Leaves mostly fallen	Sept. 18–Nov. 24	Nov. 13

Seed production and dissemination.—Red alder seed production begins at approximately 10 years of age (6 to 7 inches d.b.h.) and continues to maturity. Optimum seed-bearing age is 25 years (10 to 12 inches d.b.h.) Most trees in a stand produce cones since red alder seldom survives unless it maintains a dominant or codominant crown position. Red alder is a prolific seeder; it bears good seed crops about every fourth year with light crops in intervening years. Absolute seed crop failure is an extreme rarity, but may occur as it did in 1956 following the severe November 1955 freeze. Alder seed, though not a preferred food of the deer mouse, is eaten by it when other food is difficult to obtain (*14*). No other animals or insects are known to substantially reduce potential seed crops.

Seed dispersal begins shortly after conelets ripen in September and continues through the fall and winter. Natural seed fall is commonly observed on fresh snow in late fall and early winter. The seed is light, averaging 666,000 to the pound, and is carried great distances by wind. Wind dissemination is so effective that abundant seed for natural regeneration is normally assured throughout the range of red alder.

Seedling development.—Alder seeds germinate freely under field conditions, particularly on mineral soil, although seedings can become established on litter. Full overhead light is necessary for best results; young seedlings can tolerate partial shade up to 2 or 3 years but after that full overhead light is necessary. Abundant soil moisture and cool temperatures are important prerequisites for red alder establishment. Natural enemies of alder seedlings are not serious, and abundant survival is normal.

Red alder regeneration will probably be favored by either clear cutting or large group cutting (*8*, *19*). Any method providing full overhead light and considerable exposure of mineral soil will safely reproduce the tree if adequate moisture is available.

First year growth of red alder seedlings is rapid. The root system quickly penetrates into mineral soil and develops lateral roots. Where moisture is adequate, first year shoots are 6 to 18 inches in length. Subsequent height growth is even more rapid. Average 5-year-old seedlings on good sites are 15 feet, while 10-year-olds may be 35 to 40 feet. After approximately 10 years, height growth slows down to 2 to 2½ feet per year.[2]

Red alder is usually the first tree species to become established in areas where moisture conditions are at all favorable for it. Its rapid initial height growth permits it to overtop all conifer associates during early development. At approximately 25 years, Douglas-fir, its chief competitor, usually overtakes it in height.

Seasonal radial growth begins before height growth. At the McCleary Experimental Forest, Grays Harbor County, Wash., radial growth began on April 7 in 1955 and on May 6 in 1954, a late growing season. Radial growth continued for an average period of 130 days, which was somewhat longer than height growth. Time and period of growth were essentially the same as for Douglas-fir.

Vegetative reproduction.—Young red alder trees sprout vigorously from the stump, depending on the season cut. Older trees, however, seldom sprout and the coppice method of regeneration cannot be relied upon after merchantable trees are harvested. Cuttings do not root easily.

Sapling Stage to Maturity

Growth and yield.—The largest living tree recorded is 34 inches in diameter and grows in Olympic National Park, Wash. (*6*). Maximum tree size on better sites is 24 to 30 inches in diameter and 100 to 130 feet in height. However, a tree 52 inches in diameter has been reported on the Wynooche River in the same State.[3] These larger trees contain 800 to 1,500 board feet, Scribner rule (*9*). Red alder, even on the best sites, is exceeded in height and diameter by cottonwood at any comparable age, and by conifers after the first 50 years. Red alder is short-lived—maximum age is approximately 100 years. Maximum volume on the better sites of red alder stand is reached in 50 to 70 years.

On a good site in the Puget Sound area red alder may be 18 feet tall at 5 years, 40 feet at 10 years, and 65 feet at 20 years. Under normal forest conditions on good sites in the North Puget Sound area, trees may reach the following heights and diameters (*12*).

Age (years)	*Height (feet)*	*D.b.h. (inches)*
25	78	10
30	82	11
35	86	12
40	90	13
45	94	14
50	98	16
55	101	17
60	105	18

Over extensive areas, not over one-third of the red alder volume normally occurs in pure stands; the remainder occurs in stands dominantly coniferous. The best examples of growth and yield data are shown in table 2. Where red alder grows in pure or nearly pure stands, yields up to 6,150 cubic feet and 20,000 to 30,000 board feet Scribner per acre are possible at age 50–70 years (*18*). Mixed stands containing 500 to 3,500 board feet Scribner of red alder per acre, representing 5 to 12 percent of the total stand volume, are more common.

Reaction to competition.—Alder is generally considered an intolerant tree (*1*). It is less tolerant than bigleaf maple, Douglas-fir, western hemlock, western redcedar, and grand fir, but more tolerant than cottonwood, quaking aspen, and western birch.

When growing in pure stands, most trees that fail to maintain a position in the upper crown canopy quickly die (*2*). Thinning at an early age is recommended to salvage this mortality. A pure, 26-year-old stand responded well to release by thinning in the first 6 years following treatment (*13*).

Red alder is prone to form epicormic branches from dormant buds, particularly if a sudden increase of light is introduced. There may be other factors not yet known that account for this phenomenon (*3*, *17*).

Principal enemies.—For about the first 40 years, red alder is exceptionally free from disease and other damaging agents (*12*). White heart rot

[2] Lloyd, William J. Contrasting characteristics of Douglas-fir and red alder as affecting the management of mixed stands. Paper presented at Northwest Scientific Association meeting. December 1952.

[3] Walmsley, Cyril E. Information in files of Simpson Timber Co., Shelton, Wash. 1958.

TABLE 2.—*Examples of red alder mean annual increment and total yield in the Pacific Northwest*

Location	Age of stand	Yield		Mean annual increment	
	Years	*Cubic feet*	*Board feet*	*Cubic feet*	*Board feet*
Western Oreg. and Wash.[1]	47	4,500	21,663	103	480
Siuslaw N.F., Lane County, Oreg.[2]	60	----------	10,510	----------	175
Soil Conserv. Serv., Snohomish [3]	32	4,388	----------	137	----------
McCleary Expt. Forest, Grays Harbor County, Wash.[4]	45	4,650	20,395	103	453
Large private land holdings, SW Wash.[5]	50	2,660	----------	53	----------

[1] Johnson, Herman M., Hanzlik, Edward J., and Gibbons, William H. Red alder of the Pacific Northwest, its utilization with notes on growth and management. U.S. Dept. Agr. Bul. 1437. 1926.

[2] Aufderheide, Robert. Some notes on alder management. Unpublished manuscript on file at Pacific Northwest Forest and Range Expt. Sta. 1950.

[3] Lloyd, William J. Alder thinning progress report. Woodland Conserv. 3, Soil Conserv. Serv. Tech. Note. 1955. Portland, Oreg.

[4] Worthington, Norman P. Fourth ann. sup. to McCleary Expt. Forest Mangt. Plan. Pacific Northwest Forest and Range Expt. Sta. 1953.

[5] Data on file at Puget Sound Res. Center, Olympia, Wash.

(*Fomes igniarius*) is the most destructive disease of the live tree and is particularly prevalent on injured trees and in overmature stands. The cankers (*Didymosphaeria oregonensis* and *Hymenochaete agglutinans*) attack young trees causing some deformation and stunting of growth, but aggregate damage is slight.

Two tent caterpillars (*Malacosoma pluviale* and *M. disstria*), a sawfly (*Memichroa crocea*), and a flea beetle (*Altica ambiens*) periodically consume red alder foliage over considerable areas. Such defoliation presumably decreases growth in the year of attack, but is of no great importance because outbreaks soon subside and practically all the trees recover. The alder bark beetle (*Alniphagus aspericollis*) commonly attacks and kills trees weakened by other causes. Several species of flat-headed borers and ambrosia beetles mine in the wood of seriously weakened red alder, but do not themselves kill trees.

Damage by fire is unusual because inflammable debris is usually scarce under a red alder stand. The bark, although thin, is sufficiently fire resistant to protect the tree from light surface fires. Often red alder serves as a firebreak to protect adjacent conifer stands from fire damage (*11*).

RACES AND HYBRIDS

Thus far no evidence of races in red alder has been uncovered. A rare variety (*A. rubra pinnatisecta*) has been reported in Snohomish County, Wash.,[4] at two widely separated points on Vancouver Island, and near Portland, Oreg. (*7*).

Red alder has been crossed with *Alnus glutinosa* by Swedish workers, and the resultant hybrids exceed *A. glutinosa* in height growth. Swedish geneticists have found alder easy to work with because it flowers early and regularly, grafts easily, produces abundant pollen and seed, and is generally self-fertile (*10*).

[4] Reported by William J. Lloyd, Soil Conserv. Serv., Seattle, Wash.

Revised from "Silvical Characteristics of Red Alder," by Norman P. Worthington. U.S. Forest Serv. Pacific Northwest Forest and Range Expt. Sta. Silvical Ser. 1, 15 pp. 1957.

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